Smart Grid Initiatives

CEC PIER Workshop
September 29, 2009

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Chief Engineer - Smart Grid

Vision Statement

Smart Grid will provide environmental and economic benefit by transforming the energy value chain via an evolving energy and information network that is resilient, open, and dynamic; enabling the active participation of customers, utilities, and suppliers in energy usage and supply decisions.

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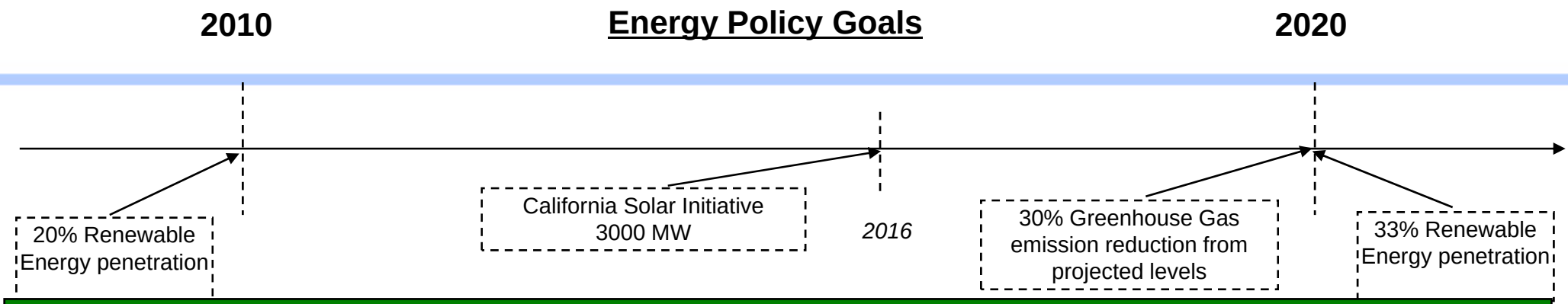
A Sempra Energy utility

SDG&E Smart Grid Roadmap



2009 - 2011

Deploy base technologies
- ✓Smart meters installed
- ✓OMS/DMS system
- ✓Microgrid Pilot

New Customer programs offered by Utilities
- ✓ Dynamic Pricing
- ✓ EE, Demand Response
- ✓ HAN, Energy Management

Many Smart Grid components are initially deployed
- ✓Self-healing-grid technologies in full deployment
- ✓Microgrid technology deployed and self sustaining community concept demonstrated
- ✓PHEV infrastructure pilots

2012 - 2015

Automated outage detection, restoration, and customer notification
- ✓Expanded SCADA & line devices
- ✓Self Healing Grid technologies in place

Traditional utility relationship with customer is changing due to more mature new services for customers
- ✓Load control with DR
- ✓Bundled services
- ✓DER Aggregation (including PHEV)

Major regulatory issues are solved
- ✓Data ownership and access
- ✓Cross jurisdictional conflicts
- ✓T&D renewables strategy

2016 - 2020

Customer supply side & storage decisions become the norm
- ✓Significant DER Penetration
- ✓Additional Microgrids where cost effective
- ✓“Customers as resources”

PHEV adoption rises- utility becomes "gas station of the future“
- ✓PHEV adoption emerges as a critical component of DER
- ✓Charging infrastructure in place
- ✓PHEV rates in place (charge & discharge)

Advanced grid technologies in place
- ✓CBM, Cable Diagnostics
- ✓Advance Energy Storage to support RPS goals
- ✓Self-healing grid is a reality

AMI Business Case Overview

$572MM Capital/O&M approved April 2007

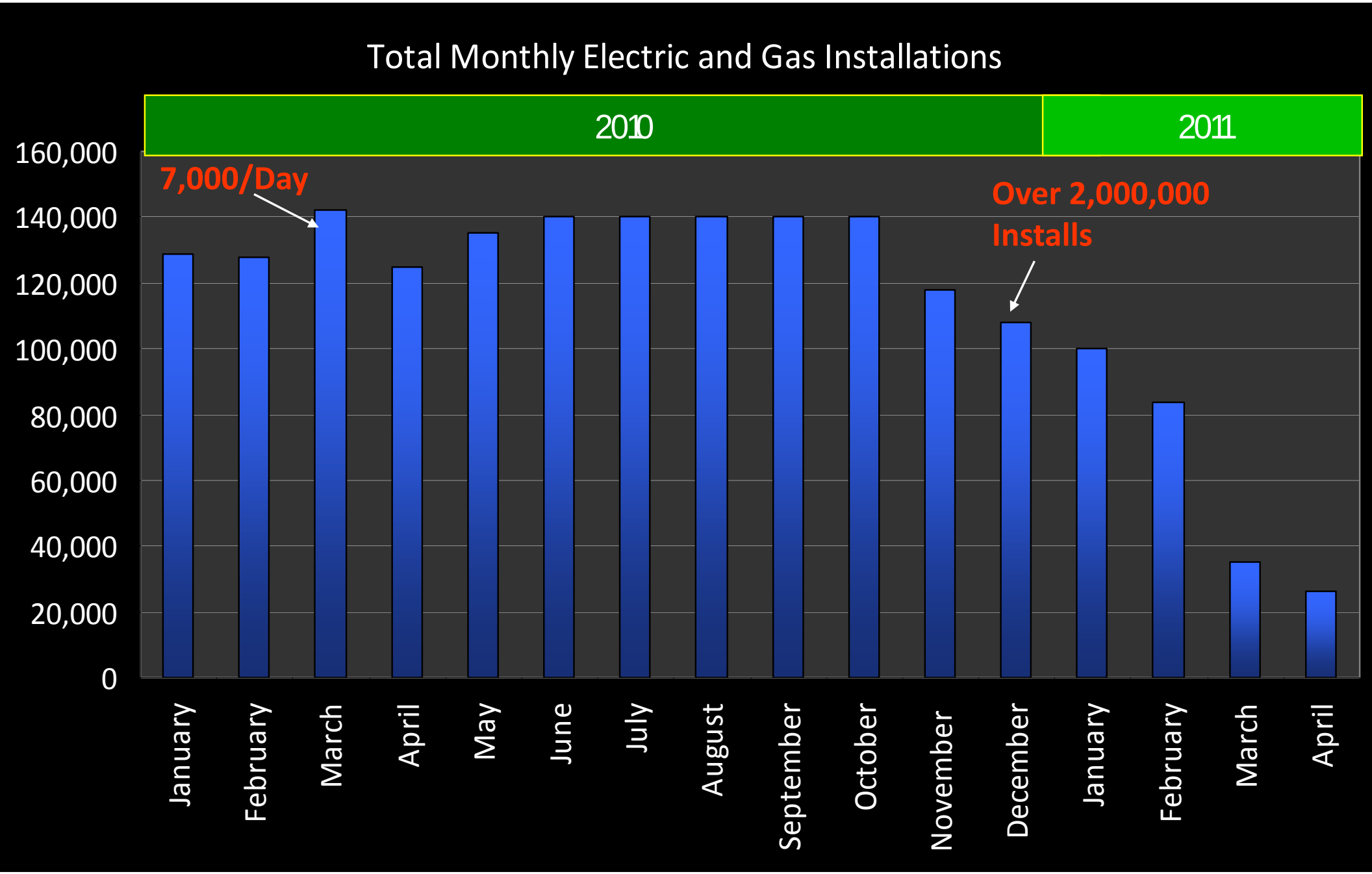
- Install 1.4 million smart/AMI electric meters for all customers
  - Solid-state electric meter technology with ZigBee chip
    - 2-way communications
    - 4 channels
  - Electric interval data reads
    - Residential hourly, C&I 15 mins.
  - Remote disconnect/connect integrated within 200 amp meter
    - Programmable load limiting switch
  - On demand reads, demand reset
- Adding module to existing 900,000 gas meters
  - Daily gas reads

AMI Business Case Overview cont.

- Next-day data for customers online/phone
- Home area network (HAN)
  - Local connectivity to remote devices, load control technology
  - Case includes 57K programmable communicating thermostats (PCTs) for Small/Medium C&I
- 55% Operational benefits, 45% Demand Response
- Support price responsive tariffs (TOU, CPP, PTR, etc.)
- Information systems, integration with legacy systems
- Firmware downloadable to the meter
- Remote device configuration/firmware & feature updates
- Tamper/theft
- Voltage
- Outage/restoration
- Security

Vendor and technology neutral as possible

2,000,000 by Year End 2010



OpEx 20/20 – Smart Grid Foundation

OpEx 20/20 includes 20 enterprise technology and process initiatives that will upgrade capabilities over a 15 year period in:

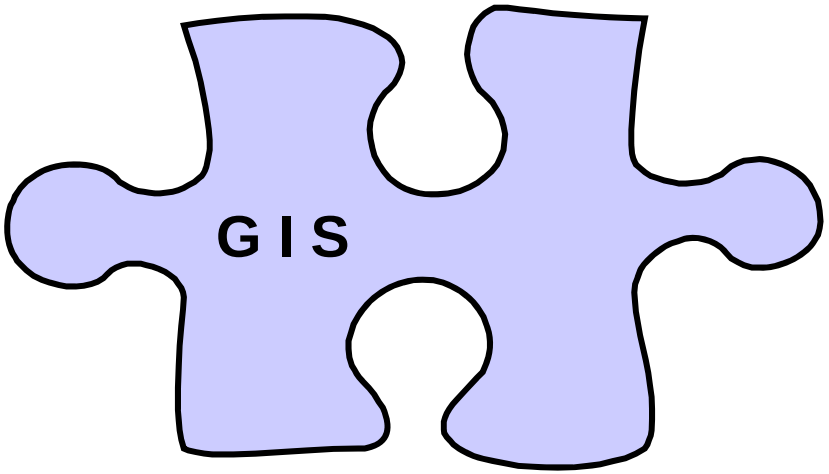
- Transmission & Distribution for Electric and Gas Operations
- Back-office Field and Mapping Support
- Customer Services Field
- Customer Contact Centers
- IT Infrastructure and Network

Formula for Operational Success

GIS + CBM + OMS/DMS + AIS = Operational Excellence^2

The Asset Management Stream will enable us to view, correlate, and use information in a way that we never could before.

Geographical Information System



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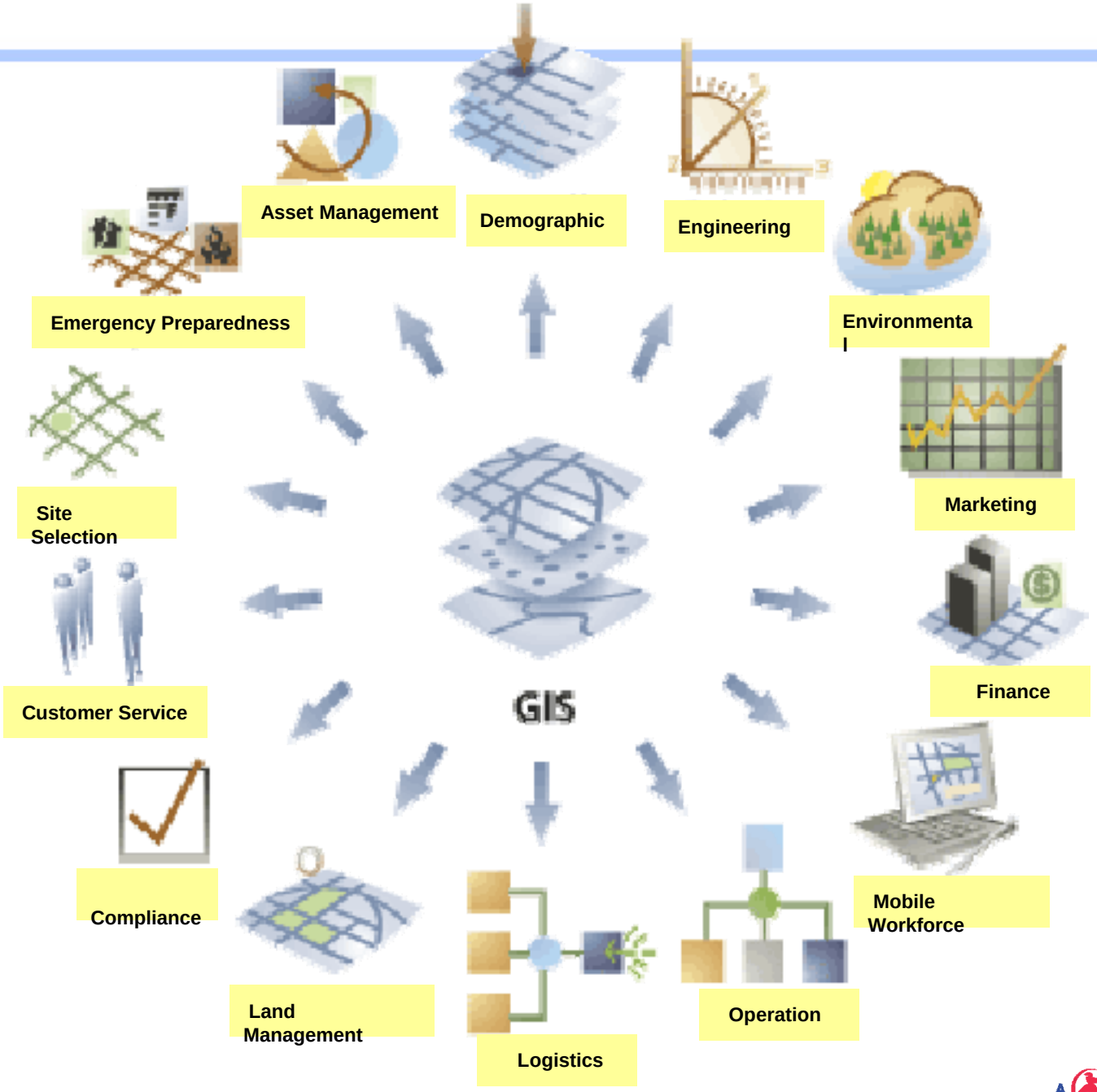
GIS – What will be different tomorrow? Central user application interface.



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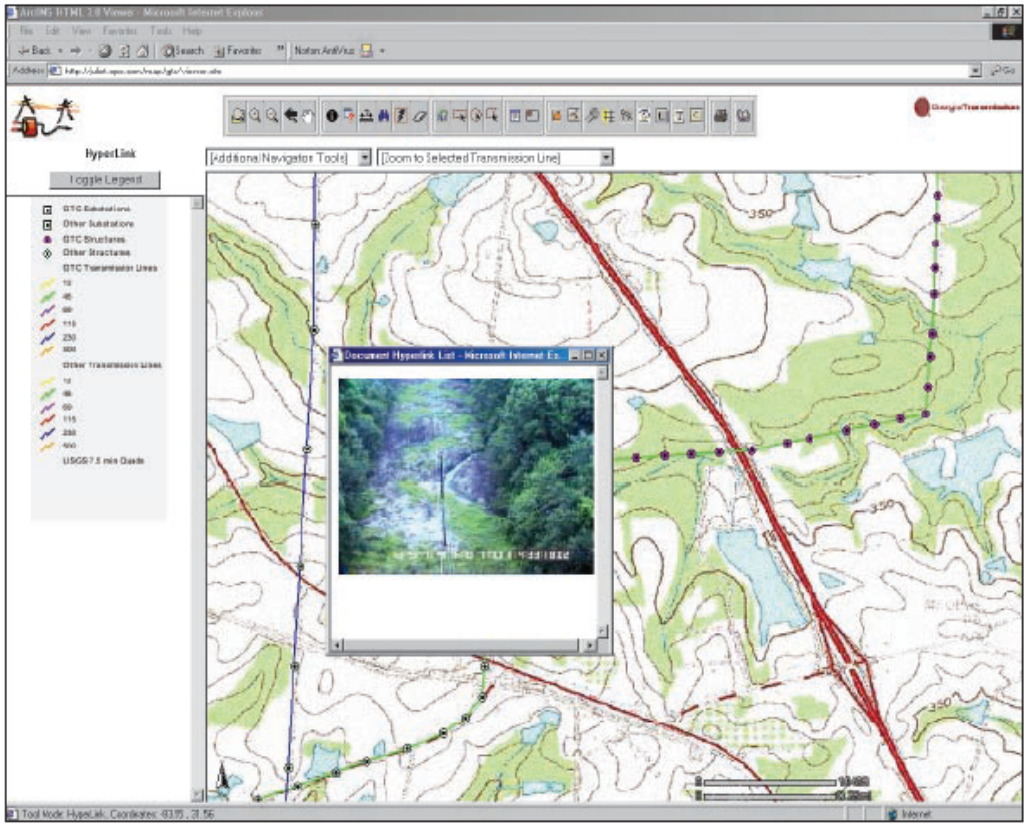
GIS – What Will Change?

Centralized Data Repository

- **Integration of maps, databases, and image files from separate areas of the company in a single accessible common interface by using a web application.**
- **Employees will be able to access all data from a central location at their office desktop or field data terminal.**



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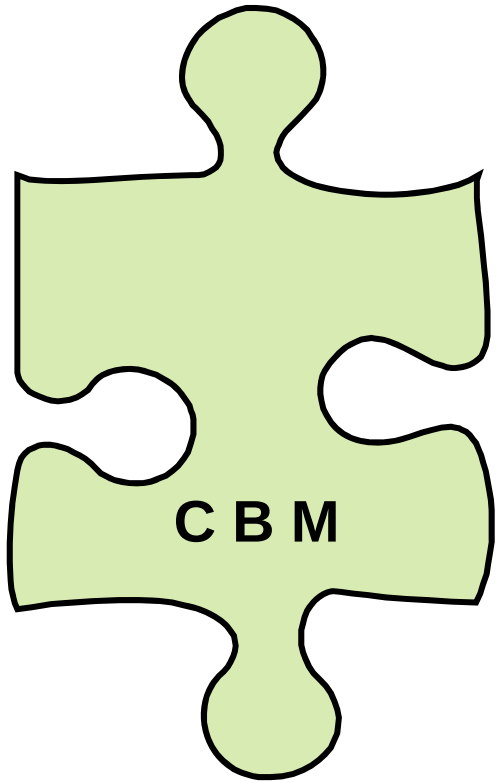
Condition Based Maintenance



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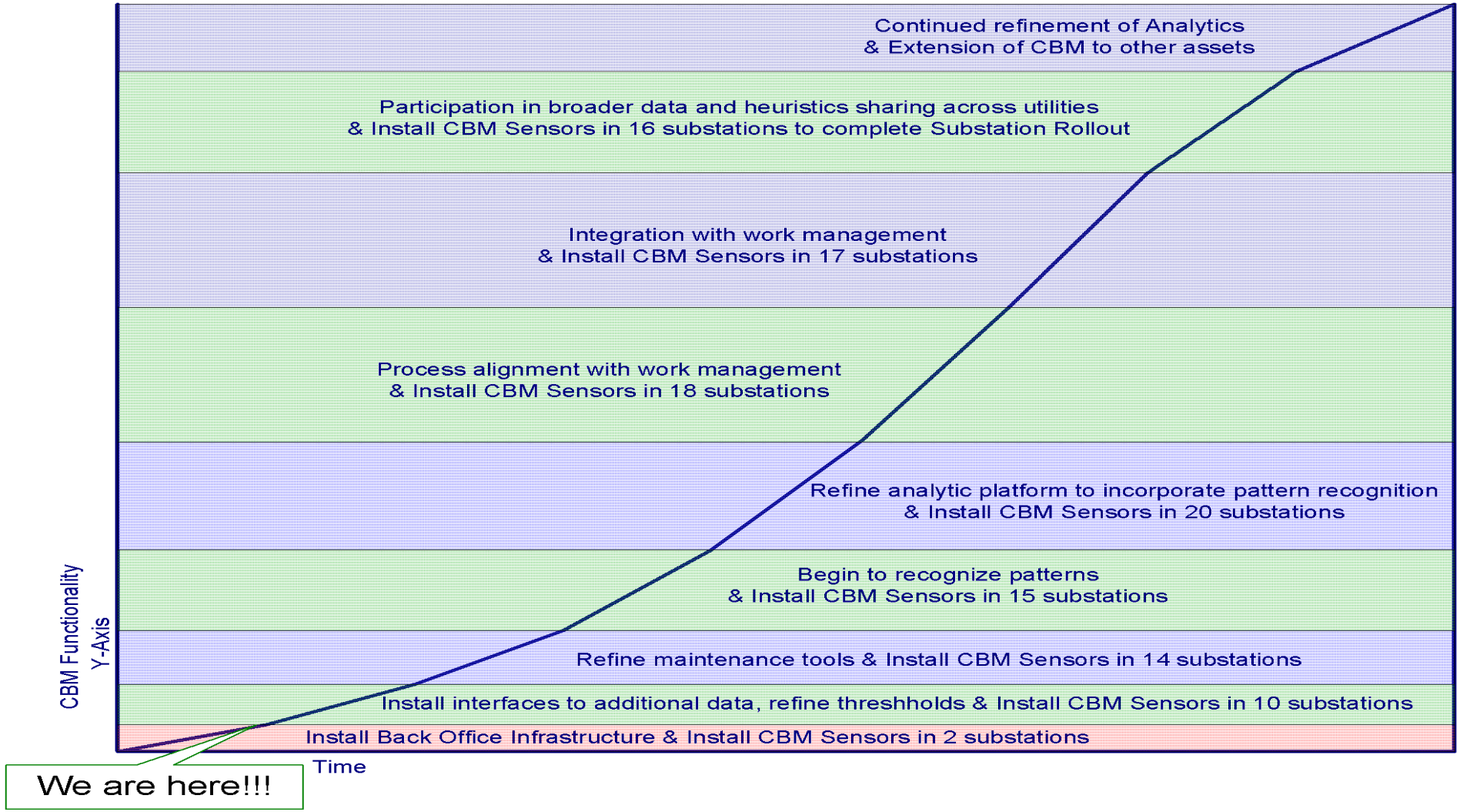
Projected CBM Lifecycle



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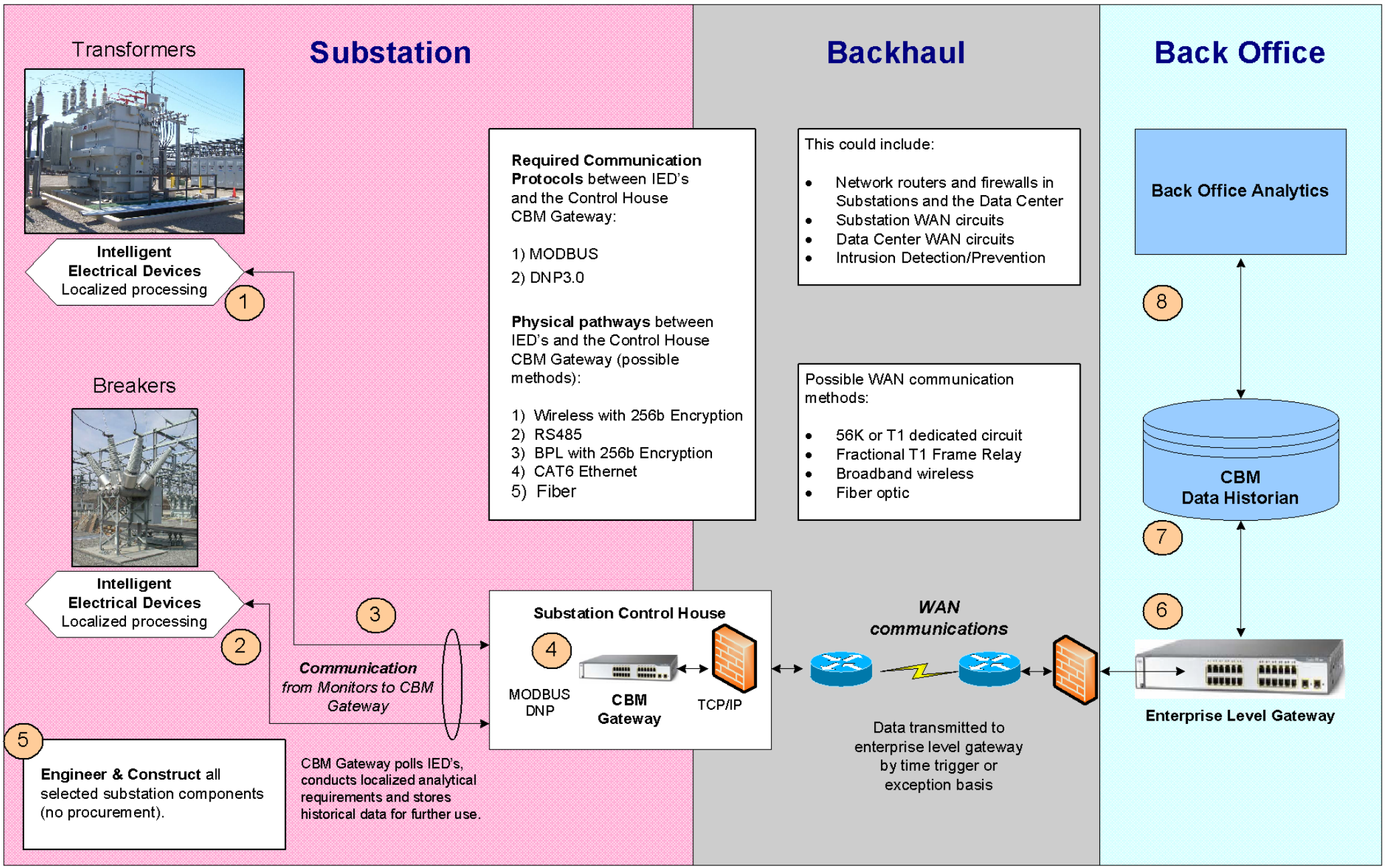
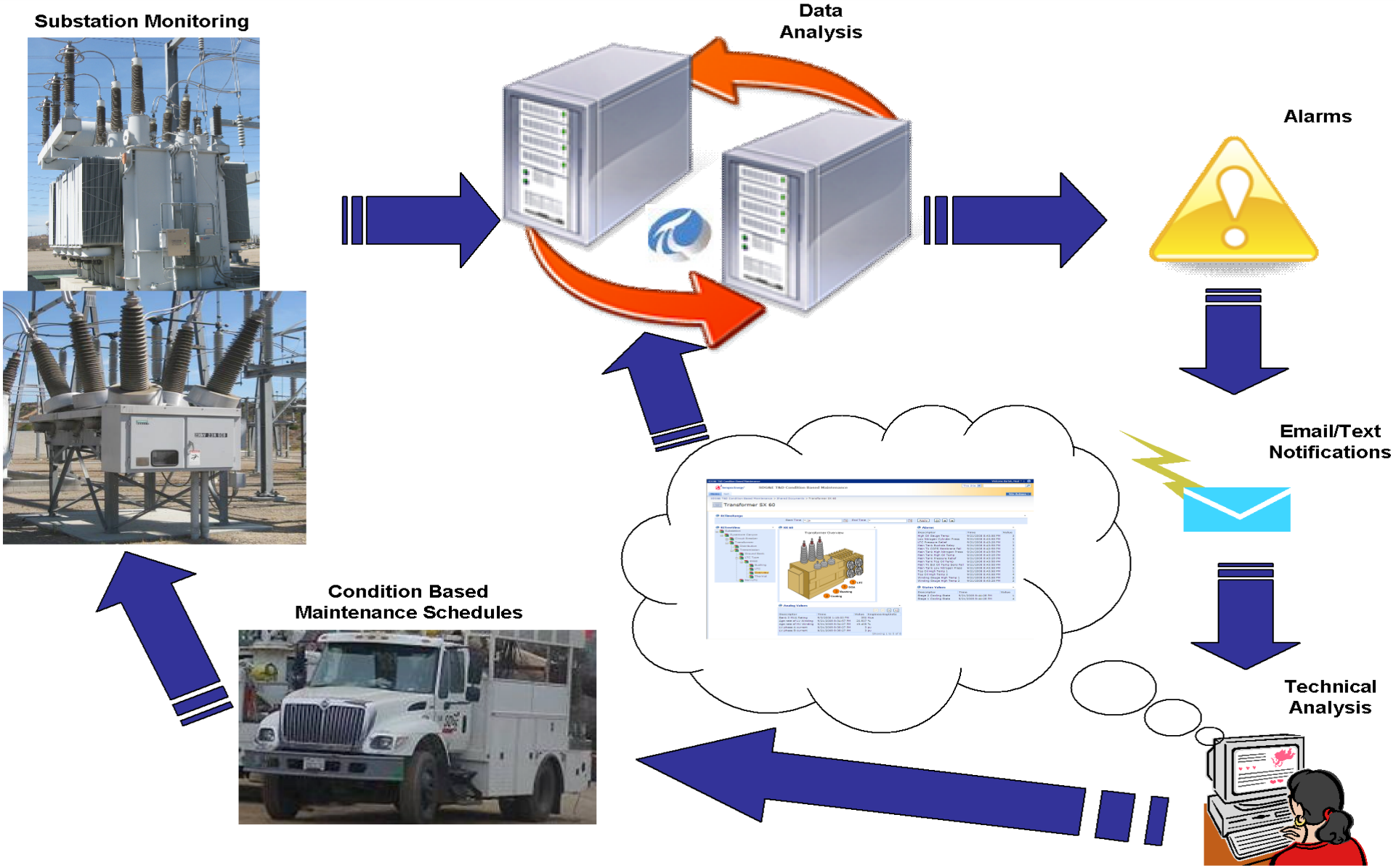
CBM Solution



High Level Data Flow Process



Notifications

From: opex2020cbm@semprautilities.com
To: CBM-XfmrLv4 Ack
Cc:
Subject: SX_BK71_THER_AlarmLevel4

Sent: Wed 1/21/2009 11:57 AM

Name: SX_BK71 THER AlarmLevel4
Description: Bank 71 Thermal Alarm Level 4
Server:
Database:
Start Time: 1/21/2009 11:56:24 AM Pacific Standard Time (GMT-08:00:00)
Trigger Time: 1/21/2009 11:56:24 AM Pacific Standard Time (GMT-08:00:00)
Target:
Value: Alarm 4
Priority: Normal

Link:
SX - BK71 - Thermal

Actions:
Acknowledge
Acknowledge with comment

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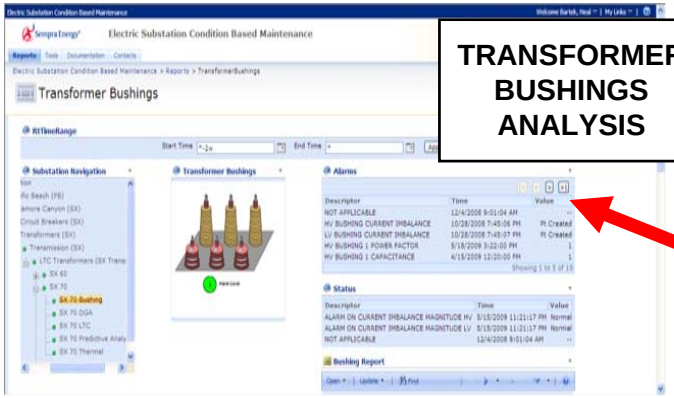
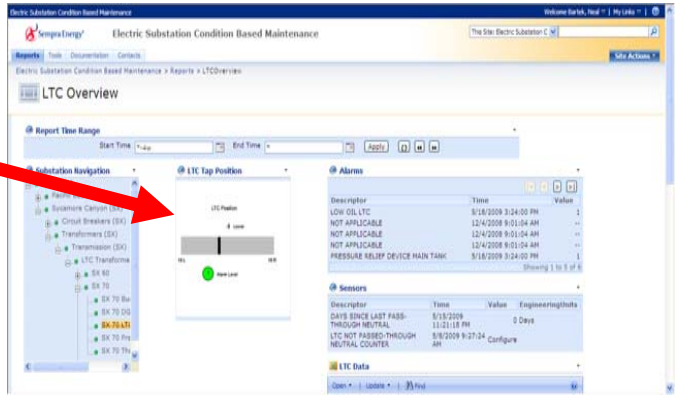
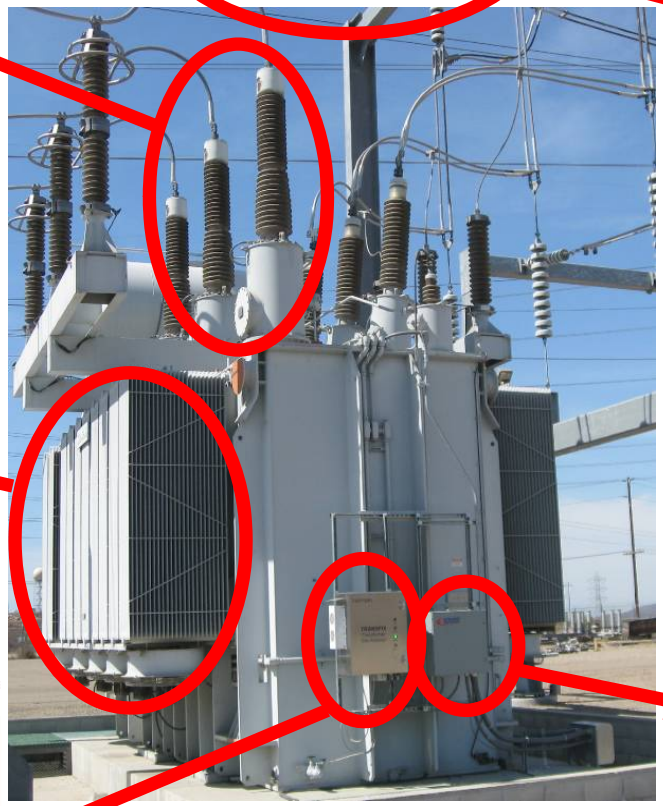
CBM Reports



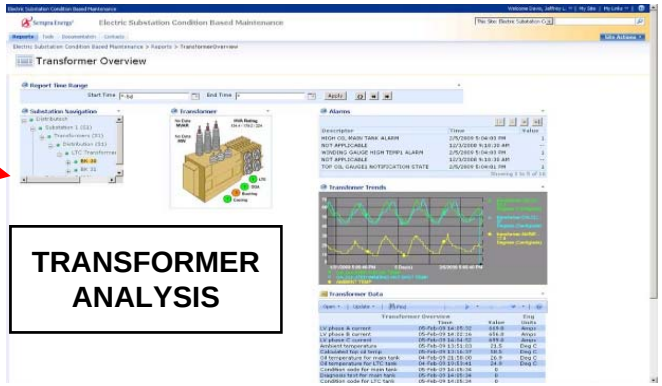
TRANSFORMER BUSHINGS ANALYSIS

LTC energy is measured at the control cabinet on the other side of the bank

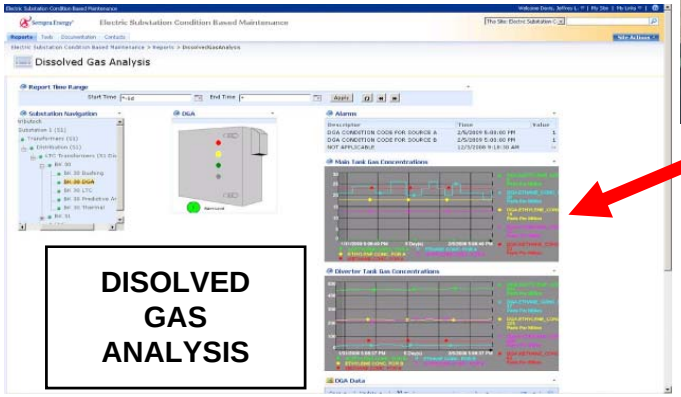




TRANSFORMER COOLING ANALYSIS



TRANSFORMER ANALYSIS



DISOLVED GAS ANALYSIS

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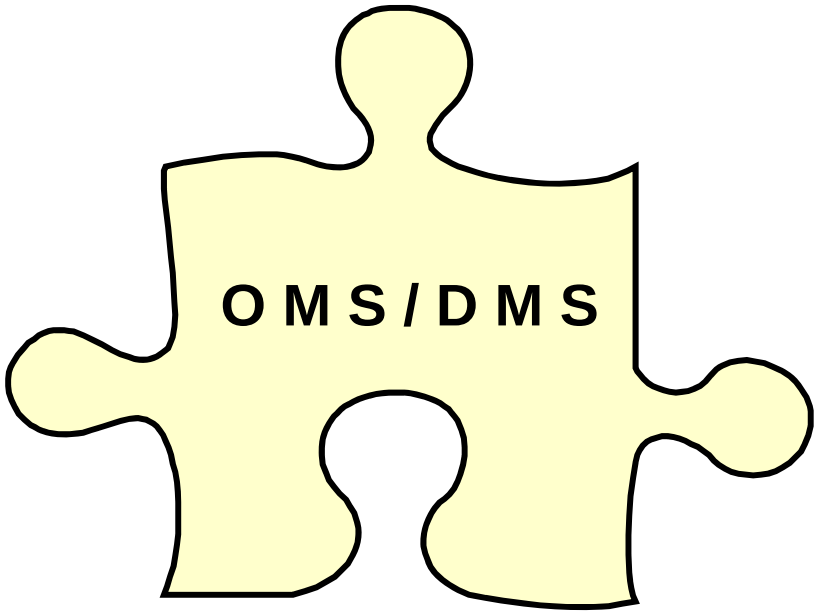
Outage Management System / Distribution Management System



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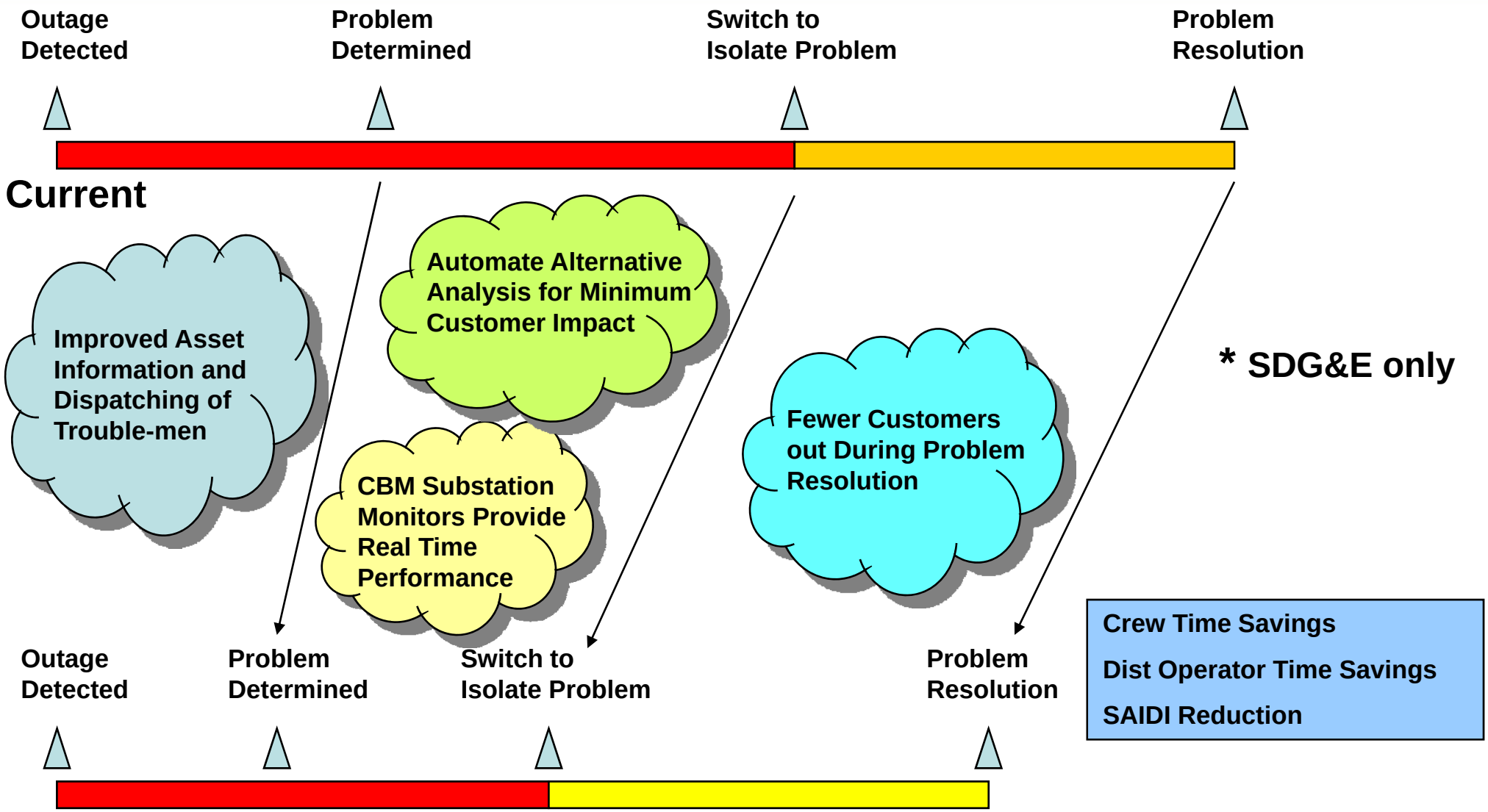
OMS/DMS Current vs. Future State



Future

- Quicker identification & restoration of outages
- Reduced customer impact

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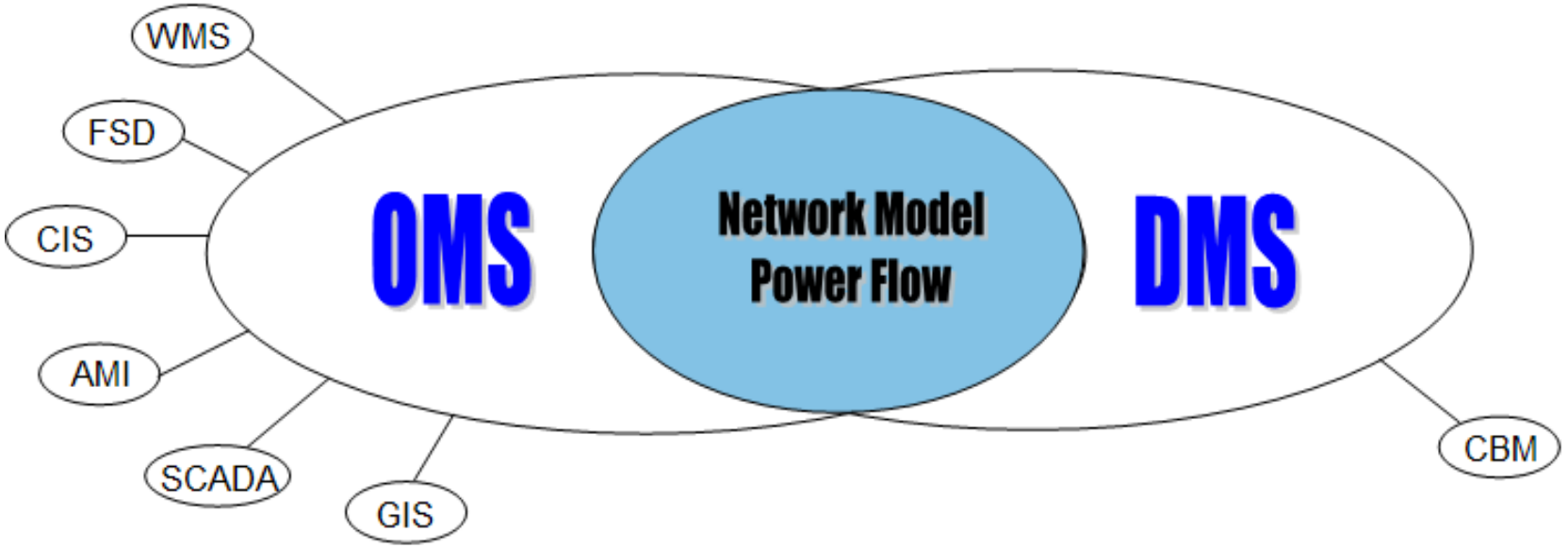
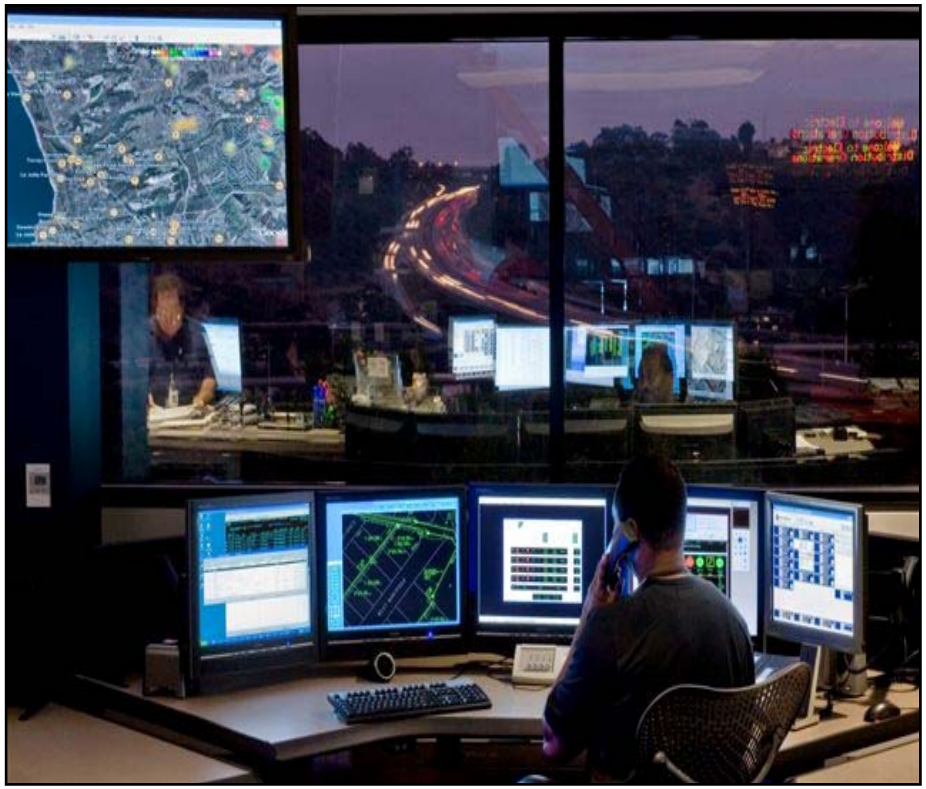
OMS/DMS Integrations



- WMS – Work Mgmt System
- FSD – Forecasting, Scheduling & Dispatch (Mobile)
- CIS – Customer Information System
- AMI – Smart Meter
- SCADA – System Control and Data Acquisition
- GIS – Geographic Information System
- CBM – Condition-Based Maintenance

OMS/DMS Timeline

- Oracle was chosen as the software vendor for the project
- Completed Requirements Phase
- Currently in Detailed design scheduled to be completed in November 2009
- Project implementation date is on target for 2011



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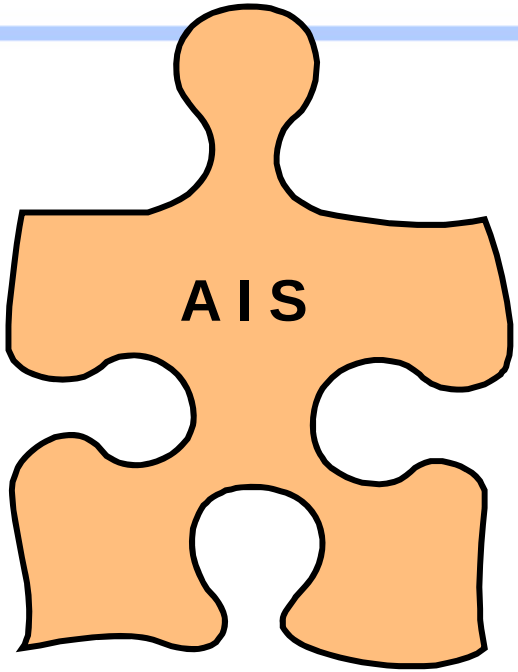
Asset Investment Support



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Investment Decision Making – Future State

Project Prioritization Tool

Risk Assessment
GIS Asset Register
Asset Condition
System Models (OMS/DMS & CBM)

KPIs
Budget Forecast
Supply/Demand

Centralized Asset Management Group SEU

Deliberation
Decision-Making

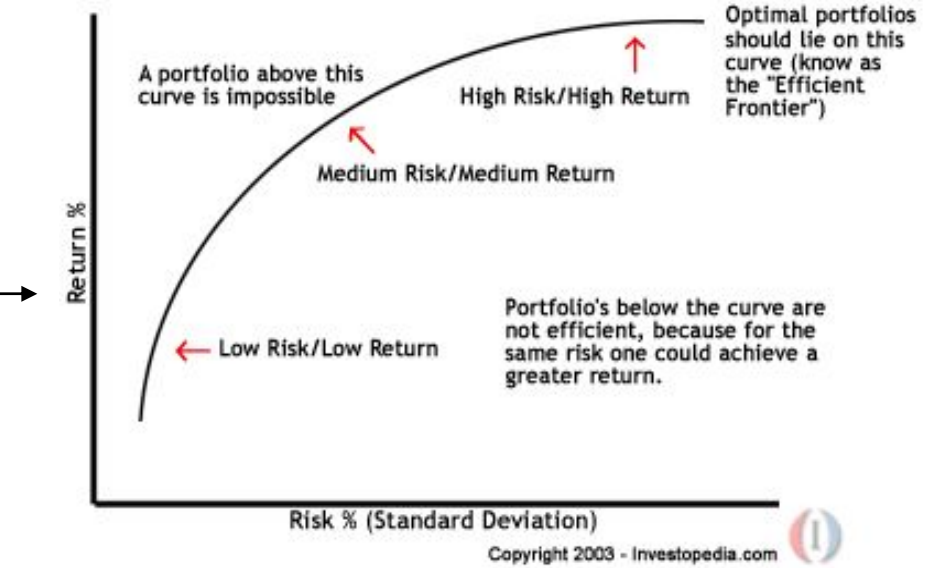
Link Between Electric & Gas Operations and Financial Strategy

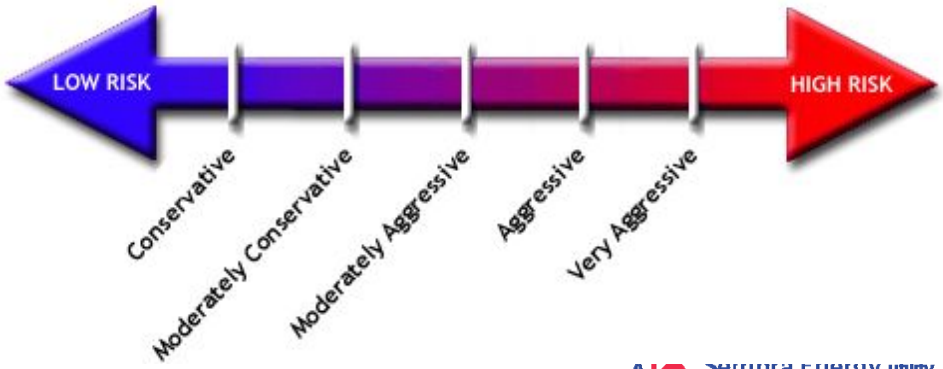
Future State - Investment Decision Making Impacts

What Will Change?

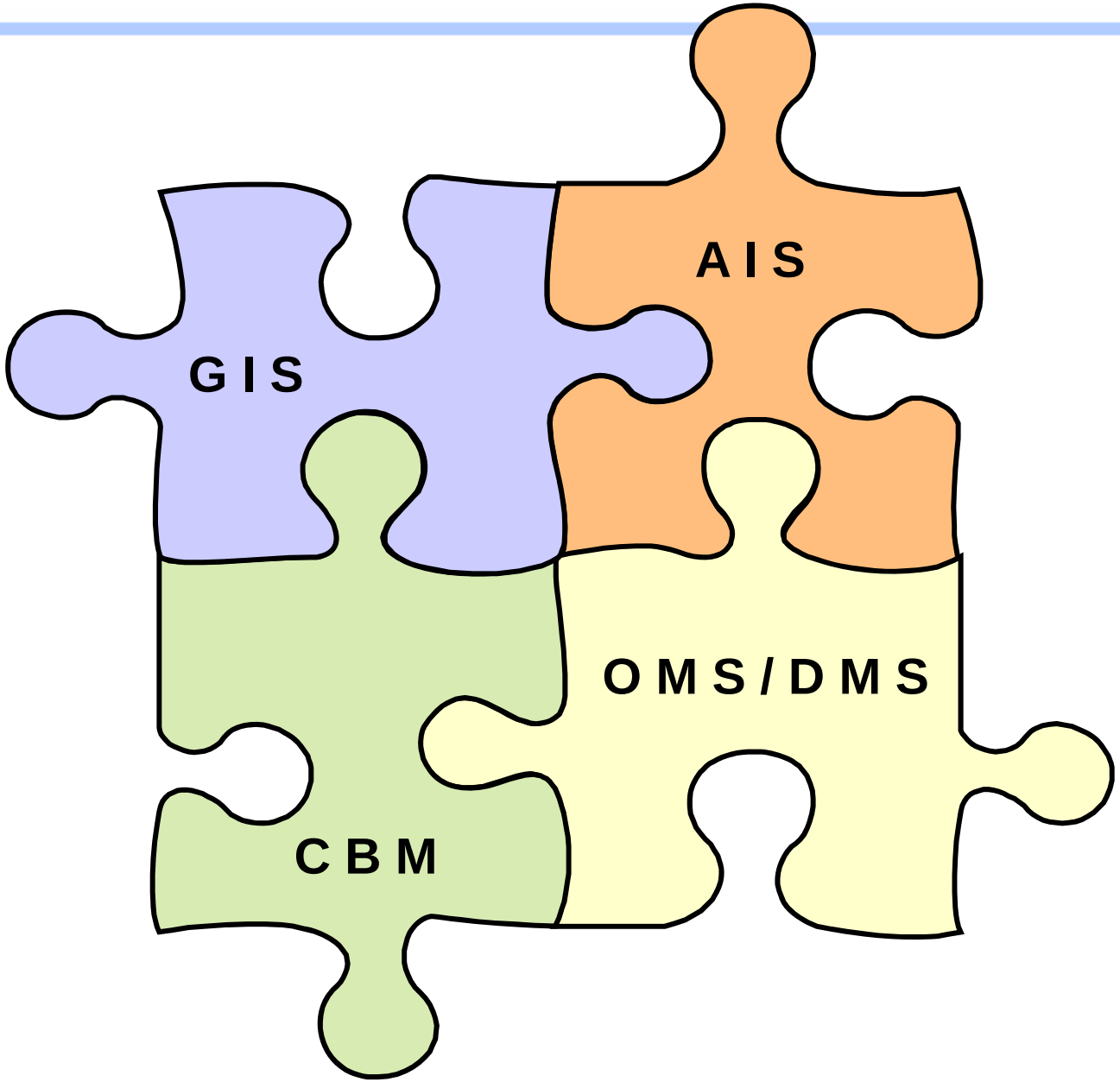
- Centralized approach to electric and gas asset investment decision-making
- Asset management decision-making performed by appropriate mix of skilled personnel (engineering, finance, field experience, etc.)
- Link between SoCalGas and SDG&E Electric and Gas investment decision-making through the use of standard tools

The Result…..Optimal financial performance with respect to capital utilization, operating margin and ROIC for Electric & Gas Operations





Asset Management Stream



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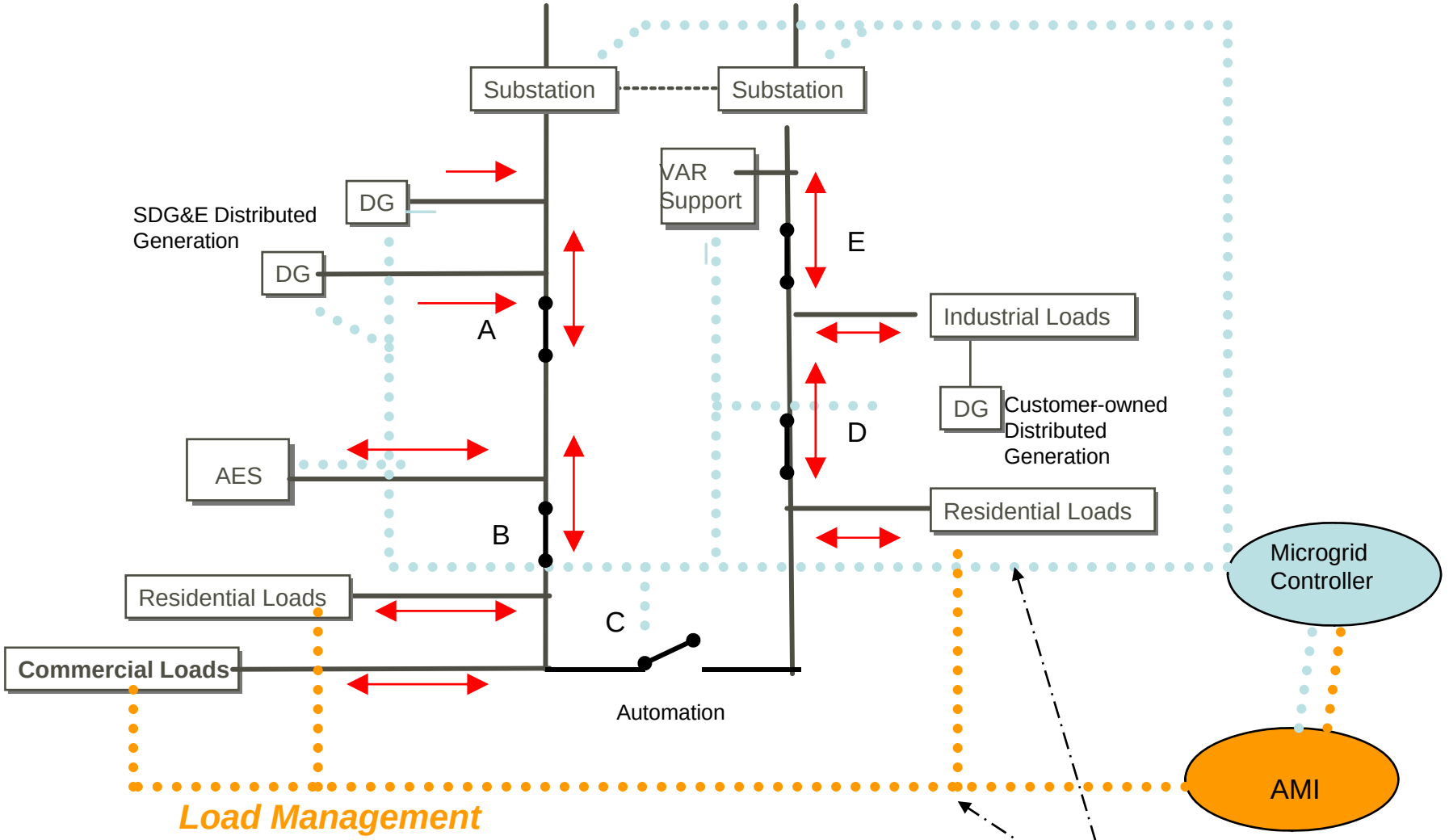
SDG&E Microgrid Concept



Microgrid Strategies

Design and demonstrate a smart electrical grid that incorporates sophisticated sensors, communications, and controls in the following ways:

- Intelligently incorporate solar power generators on homes and businesses into the electrical delivery system.
- Enable coordinated Demand Response (DR) programs whereby heavy electrical use during peak demand periods can be moderated to prevent electrical supply emergencies.
- Integrate and control multiple distributed generation and electrical energy storage devices to operate the grid in a more cost-effective and reliable manner, benefiting customers and electrical rates.

Proactively identify and apply leading-edge technologies to improve security and reliability of electric supply and to lower costs to consumers.

Microgrid Issues and Challenges

Integration of Distribution Energy Resources

Distribution Automation

Asset Management

Security – Cyber & Physical

Tariff Development

Customer Participation

Cross-jurisdictional Issues

Microgrid Project Overview: Goals & Scope

SDG&E's Microgrid project integrates a DOE component, focused on feeder applications and a CEC component, focused on customer-side applications

MicroGrid Project

DOE Portion

- $7.2M in DOE funds contribution towards $12M total project cost over 3 years
- Goal to achieve >15% reduction in feeder peak load and improve system reliability
- Perform cost/benefit analysis for full scale deployment
- Involves Integration of 5 technologies:

1. *Distrib. Energy Res. (DER) and VAr*
2. *Feeder Automation System Technologies (FAST)*
3. *Advanced Energy Storage (AES)*
4. *OMS/DMS system*
5. *Price Driven Load Mgmt (PDLM)*

CEC Portion

- Entirely CEC Funded ($2.8M)
- Sustainable Communities MicroGrid focused on interoperability, AMI and customer DER
- Schedule to mesh with larger DOE proj.
- Involves Integration of customer based technologies:

1. *Remote Controlled Demand Response Devices (e.g. Thermostats)*
2. *Solar panels*
3. *Battery storage*
4. *Plug-in Hybrid Electric Vehicles (PHEV's)*
5. *Grid-friendly appliances*

Microgrid Selected Site: Borrego Substation

Key Characteristics:

Strengths:

No residences nearby, plenty of land
More Existing Solar Customers
Large Reliability Improvements Possible
Possibility of 'Islanding' Entire Community
Great learning environment
Extendable to service territory

Challenges:

Remote Area
Challenging Communications Environment
New Fencing Required
Requires Accelerating schedule for
- Condition Based Maintenance and AMI Deployment

Borrego offers SDG&E the possibility of being able to island an entire substation with peak load of over 10 MW.

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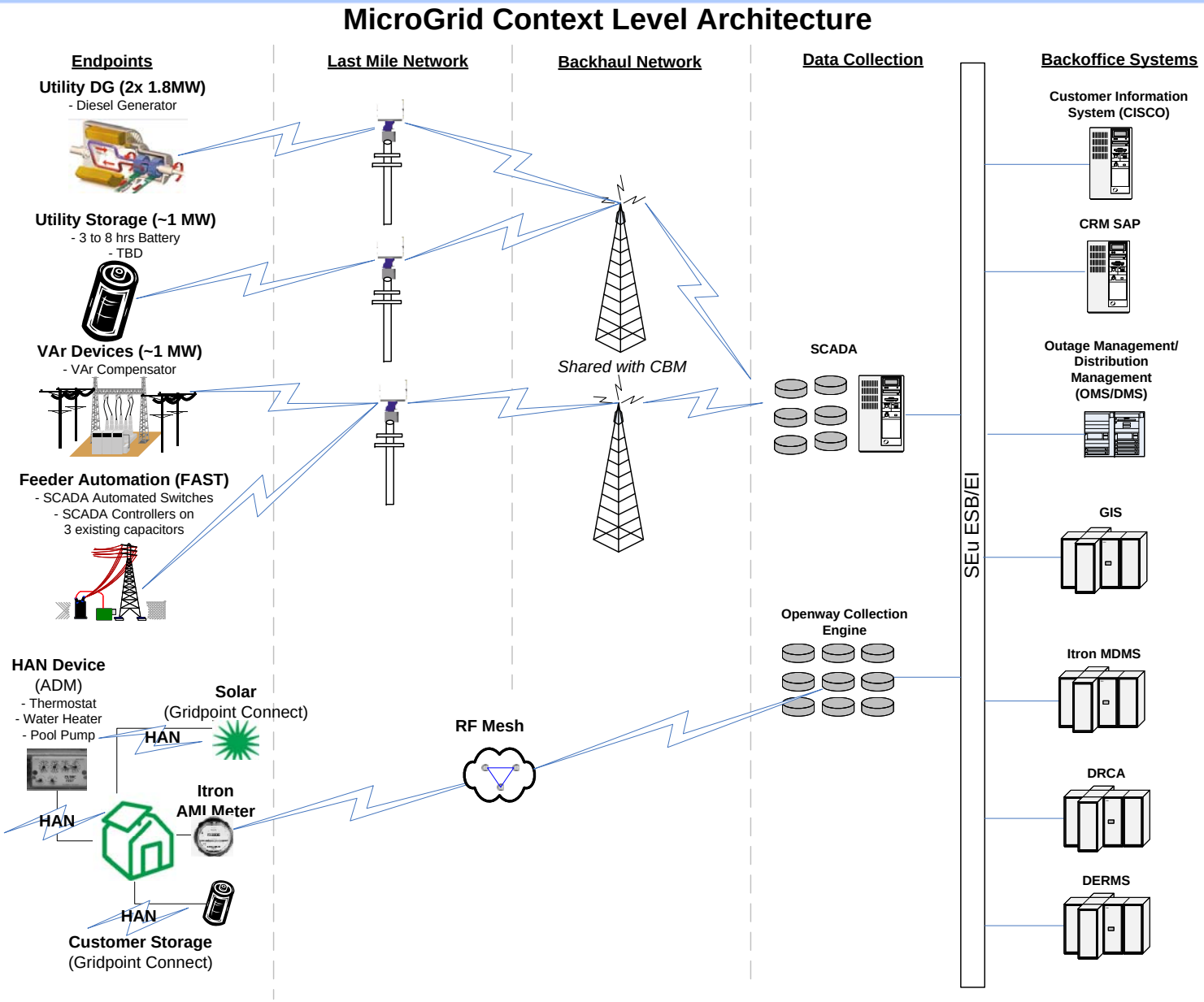
Project Architecture: Context Level Architecture



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Production – Plans and Capacity

- Fisker Karma – 15,000 per year
- Subaru Stella – 170 through March 2010
- Tesla Roadster – 500 owned by end of May 2009
- Saturn VUE – Production cancelled
- Toyota Prius – 500 for lease by end of 2009
- EPRI Trouble Truck – 50 vehicles for evaluation
- Nissan Smyrna, Tenn. – 150,000 capacity
- BMW Mini E – 500 for field trial
- Mitsubishi iMiEV – 2000 through current fiscal year, 5000 next year. (Japan)
- Aptera – 4,000 deposits beginning production in late 2009

2009	2010	2011	2012
BYD in Europe	Saturn VUE	Toyota Prius	Ford Escape
Fisker Karma	Chevrolet Volt	BYD F3DM	Hyundai
Subaru Stella	Kia LPG/Electric		
Chrysler	EPRI, Eaton, Ford Trouble Truck		
Smart for Two	Nissan LEAF		
ZENN City	BMW Mini E		
BYD EV in China	Mitsubishi iMiEV		
Tesla Roadster	Aptera		

Tesla Roadster

Prius PHEV Prototype

Nissan Leaf

BYD F3DM

PHEV BEV

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eTec Timelines

8/5/09 **eTec** selected by DOE as lead applicant and project manager to "accelerate the development and production of various electric drive vehicle systems to substantially reduce petroleum consumption."

$99.8MM in Federal Funding. **The largest EV vehicle deployment and transportation electrification project in US history.**

8/17/09 Certifications for environmental and project information

8/31/09 Establish indirect costs and industry partner subcontracts

9/7/09 Scope, costs & justification submitted

9/30/09 DOE Flow down requirements

Finalize eTec - USDOE contract

Establish budget

Statement of Project Objectives

Detailed costs

Budget justification

10/1/09 Contract in place

Launch of Program & Website

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Elements

Total Project Value of $199.6MM, Federal portion of **$99.8MM**
($19.8MM in San Diego for Federal Match regional contribution)
Note CEC AB 118 Funds may be used
Up to 5000 Nissan Leaf Vehicles nationally - (1000 in San Diego Region)
Up to 5000 Level 2 private residential chargers - (1000 in San Diego Region)
Up to 6000 Level 2 Commercial Chargers - (~1200 in San Diego Region)
Up to 2000 Level 2 Public Chargers - (~ 400 in San Diego Region)
Up to 250 Level 3 Fast Chargers - (50 in San Diego Region)

Receipt of an additional $8 MM in matching stimulus dollars on 8/28/09 from California Energy Commission to eTec will increase these numbers and project scope. These dollars can only be spent toward infrastructure projects under eTec within San Diego as it is the only California region included in the study.

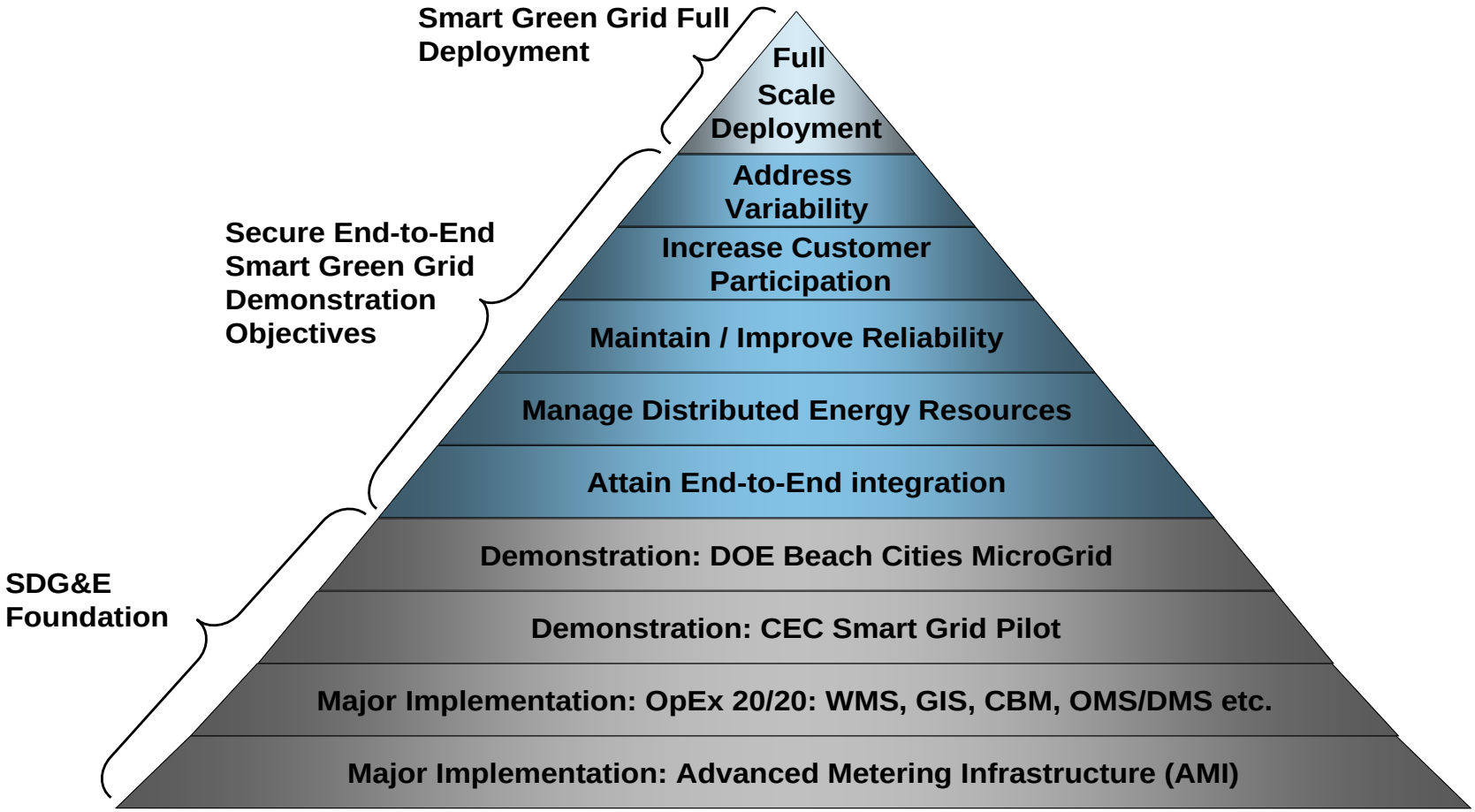
ETEC stated Electrification Project - Key Messages:

- This is the largest electric vehicle deployment and transportation electrification project in U.S. history.
- The information developed through this project will build the base for widespread use of electric vehicles nationwide.
- We will make charging a convenient part of daily life. You will conveniently charge almost anywhere: at home, at work, when you stop for coffee, where you shop, etc…
- Through this project we will clean our air, improve the overall environment, reduce dependence on oil, and reduce the cost of transportation.
- This Project will create jobs to support the new green economy.
- Extensive feasibility and planning studies will be conducted to determine where, when & how to deploy infrastructure efficiently.
- This is the 1st step towards infrastructure deployment as we do not want to spend federal funds frivolously.

Smart Green Grid Demonstration: “Bringing it all together”

The Smart Green Grid Demonstration is a critical step in preparing the utility companies nationwide to support smart grid technologies end-to-end. Enabling technologies and small scale demonstrations have been developed already but Sempra proposes an end-to-end demonstration, which will develop the necessary technology and know-how to accelerate full scale Smart Grid deployment

SDG&E Foundation for the Demonstration



Conceptual Architecture & Project Team

SDG&E's Secure End-to-End Smart Green Grid Demonstration

GE Energy

Operations Data Integration

SAIC

Cybersecurity
DHS Fusion Center

BAE SYSTEMS

Enterprise Architecture
Standards and Interoperability
DER Management

IBM

Project Management Office
Systems Integration

Grid Operations

EMS SCADA

Centralized Renewables

The Valley Group
a Nexans company

Dynamic Line Ratings

SEL Celebrating 25 Years of Innovation
S&C ELECTRIC COMPANY Excellence Through Innovation

Synchrophasors, Servers, Network Security

Battery Storage Systems

Transmission substations

SDG&E Data Centers

Advanced Applications

DERMS DFLAS PDMS DRCA AMI OMS/DMS

ESB

Directory & PKI

Monitoring Management/ Compliance

Automation

Highly Available Infrastructure

CISCO

SOA Security

Data & Storage Networks

Firewall IPS/IDS

IBM

Servers & Storage

Operational Data Historical Data

Weather Forecasts

Hosted/Cloud Services

CISCO

Online Collaboration

Smart Appliances
Home Energy Management

imagination at work

Itron Smart Meters

HAN

Residential Customers

Smart Charging and Vehicle-to-Grid

Electric Transmission & Distribution
Secure Communications Networks

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plug smart intelligent charging

TRADESCAPE

UC San Diego

Industrial Customers/Microgrids

On-Ramp WIRELESS

Wireless device communications

Predictive Analysis

Fault Analytics Volt/VAr Optimization

Distribution Substations

SEL Celebrating 25 Years of Innovation

Fault Current Indicators

Other Partners & Support

California ISO Your Link to Power

San Diego Workforce Partnership

intel

Non-compensated technical advisor

Clean Tech San Diego

EPIC Energy Policy Initiatives Center University of San Diego School of Law

Executive Summary – Project Description and Objectives

The proposed project is offered under the Program Area of Interest 1304 - Smart Grid Demonstration Projects: Smart Grid Regional Demonstration, of the DOE Office of Electricity Delivery and Energy Reliability.

Project Description:

Building upon previous initiatives, SDG&E is in the unique position to conduct a demonstration of a Secure End-to-End Smart Green Grid, from generation to consumer. The demonstration will establish operational controls, technology, and information required to realize potential efficiency, visibility, and flexibility required to achieve aggressive renewable portfolio strategy (RPS) and other regional energy policy goals, improved reliability, and energy conservation objectives. It will also will provide a foundational basis to accelerate – with confidence – the deployment of other national Smart Grid initiatives

Project Objectives:

1. Address Intermittency: Support SDG&E in reaching its 2020 goal of a portfolio of 33% renewable energy by identifying, forecasting, and mitigating the intermittency issues associated with significant portfolio of renewable energy; both wind and solar by utilizing **energy storage devices, dynamic ratings** and **PMU** technologies

2. Increase Customer Participation: Create additional opportunities for customer participation in energy usage decisions at both the residential and industrial level via **expanded price driven load management (PDLM)** capabilities that send pricing and reliability signals to 3rd parties as well as receive signals from the California Independent System Operator (CAISO)

3. Maintain/Improve Reliability: Determine how to maintain and improve operational and market efficiencies, and reliability in an end-to-end future SG environment via deployment of **expanded fault locating,** and **energy storage** technologies

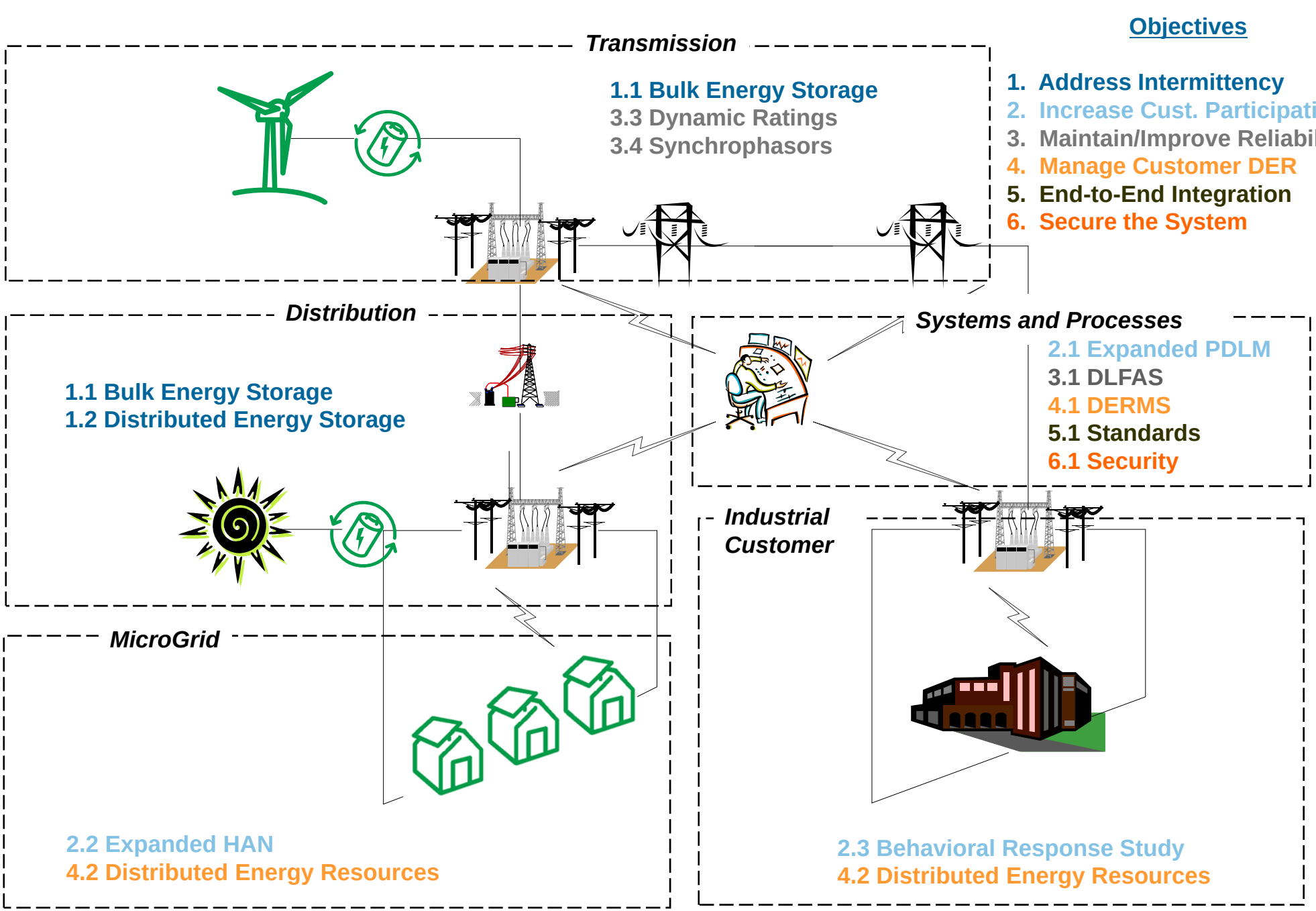
4. Manage Customer Distributed Energy Resources (DER): Explore the potential to use customer assets as resources for utilities to match load to generation, establish greater visibility into outages, dispatchable loads, and distributed customer resources for the Grid Operations Center, and provide energy usage feedback for the consumer

5. Attain end-to-End Integration: Develop interoperability and cyber security infrastructure through new **standards** that can be applied to any utility that will create a flexible, interoperable smart grid system while protecting against cyber-security threats

6. **Secure the System:** Integrate safeguards throughout the system with cyber security as a primary design element addressed throughout its architecture and oriented towards open standards and commercial solutions

Smart Green Grid Demonstration – Scope

Sempra Energy utilities



Objectives

1. Address Intermittency
2. Increase Cust. Participation
3. Maintain/Improve Reliability
4. Manage Customer DER
5. End-to-End Integration
6. Secure the System

GridComm is Sempra's concept for next generation RF communications

- Utility communications needs are stringent
  - Guaranteed capacity, latency & availability
  - Coverage of all utility assets within 24K sq. miles
  - Robust, provable security & integrity
  - Scalability up to 100K endpoints